

Making Paper

Objective

Students will read about and discuss paper production, production and recycling. Students will make their own paper. Students will conduct activities to examine their use of paper. Students will conduct a scientific experiment related to the decomposition of paper.

Background

Wasps first made paper. Many innovations are influenced by what we find in nature. People in China first produced paper, around 105 Ad. Ts'ai Lun, a court official, figured out a way to make paper by shredding the bark of a mulberry tree and mixing it with scraps of linen and hemp. He added water and beat the mixture into pulp. He made a frame of bamboo, covered the bottom with cloth, and dipped the frame into the pulp. Then he let it dry until he could pull it off the frame in a sheet.

The cell walls in most plants are cellulose, the part of the plant from which paper is made. Most paper today is made from the cellulose of fast-growing trees like the loblolly pine grown on tree plantations in southeastern Oklahoma. Agricultural researchers are also experimenting with making paper from other, even faster growing sources of cellulose, like the debris left over after harvesting crops like wheat and corn.

To make paper from a tree, the bark is stripped from the trunk, then the trunk is chopped into small chips. The chips are cooked at a high temperature with chemicals and placed on a conveyor belt that travels through several machines. The machines wash the pieces several times to create clean pulp. More machines flatten and break apart the lumpy fibers. The paper is then pressed and dried into smooth, uniform sheets and sold in large rolls called reams.

Trees are a renewable resource, which means when we cut them down we can grow more. But cutting too many of them at once can cause soil to erode. The soil washes into waterways and clogs rivers and streams. Trees also need plenty of space to grow.

Many trees today are grown on farms just to provide trees for paper and other wood products. In northeastern Oklahoma there are plantations of loblolly pine grown for that purpose. Loblolly pine is a kind of tree that grows very quickly. In some parts of the south, farmers have stopped growing crops like cotton and let their land go back to pine forest, because selling trees is more profitable than raising traditional crops.

Most of the garbage that goes into landfills is paper. Even though paper is biodegradable, it cannot break down if there is too much in one area. The volume of paper in landfills prevents it from ever having contact with soil. Soils hold the microorganisms necessary to help break it down.

Recycling paper and using products made from recycled paper will

Oklahoma Academic Standards

GRADE 4

Visual Art: 3.1; 4.4
Speaking and Listening: R.1,2,3;
W.1,2,3. Research: R.1,2,3;
W.1,3
Measurement: 2.4. Data &
Probability: 1.1,2
Earth Science: 3-1

GRADE 5

Visual Art: 3.1; 4.4
Speaking and Listening: R.1,2,3;
W.1,2,3. Research: R.1,2,3;
W.1,2,4
Measurement: 3.2. Data &
Probability: 1.2
Life Science: 2-1. Earth Science:
3-1

GRADE 6

Visual Art: 3.1; 4.4
Speaking and Listening: R.1,2,3;
W.1,2,4
Life Science: 2-3. Earth Science:
3-3

Resources Needed

Materials needed for making paper are listed on the instruction sheet

two trash containers

Vocabulary

biodegradable—capable of being decomposed by natural processes

bark—the outer covering of the woody stems, branches, roots and main trunks of trees and other woody plants as distinguished from the inner wood

cell—the smallest structural unit of an organic structure, plant or animal

cellulose—an inert, complex, carbohydrate which makes up the bulk of the cell walls in plants

consumer—someone who acquires goods or services

crate—a square or rectangular box used to carry farm products or objects

erode—to wear away by or as if by the action of water, wind, or glacial ice

felt—a fabric made from wool or animal hair by pressing, heating, or treating the fibers with chemicals

fiber—one of the elongated, thick-walled cells that give strength and support to plant tissue

(Continued on next page.)

help keep our landfills from filling up too fast. Then we can continue using our land for other purposes, like growing food.

Source: “The State of the Paper Industry: 2011,” Environmental Paper Network, <http://environmentalpaper.org>

Visual Arts

1. Divide students into groups of four or five. Provide each group with materials to make paper. Demonstrate the process, using the instructions included with this lesson.
2. Students will use the paper they made for invitations or holiday cards. Dress the paper up by adding dried herbs or flowers.
3. Visit this site for directions to make “Plantable Greeting Cards” by making paper and adding seeds:
<https://www.makeandtakes.com/handmade-plantable-greeting-card>

English Language Arts

1. Read and discuss background and vocabulary.
 - Brainstorm and list reasons people in America are no longer using more paper than the people in China. (Greater prosperity among residents of China, use of computers replacing use of paper in North America, etc.)
 - Ask students why we should be concerned that our landfills are filling up (loss of land for agricultural and other uses and the high cost to cities and counties of building and maintaining environmentally-safe landfills).
 - Students will select topics related to the background and your class discussion and write opinion papers. (Possible topics include the importance of recycling, the decline in the use of paper compared with use in China, the use of agricultural land for landfills, etc.)
2. Invite the city or county official responsible for waste management in your area to come to your class and discuss some of the costs involved with maintaining landfills.
3. Do without trashcans in your room for one day.
 - Instruct students to crumple their paper and toss it on the floor if they need to throw it away.
 - At the end of the day, discuss the amount of paper on the floor.
 - Students will inspect some of the discarded paper and discuss how much was wasted and how much was used efficiently.
 - Brainstorm to find ways to cut down on paper use in the classroom.
 - Students will pick up the paper before leaving class for the day.

Math

1. Bring two empty trash containers to class. Label one “white paper” and the other one “colored paper.”
 - Students will predict how much paper they think they use in one day. Record estimates for each student. Ask how much they think the entire class uses in one day. Record estimates.
 - Explain that for one day each student will sign or initial every sheet

of paper he/she throws in the trash. All the white paper will go in the trash labeled “white paper,” and all the colored paper will go in the trash can labeled “colored paper.”

—At the end of the day students will estimate how many sheets of paper are in each recycling box. Each student will estimate the number of sheets of paper he or she personally used. Check the results by counting and recording this information on the board for everyone to view.

—Students will estimate the length of the papers if placed end to end in the hallway. Students will line the hallways with the paper and measure to check their estimates.

—Students will create bar graphs showing the total amount of paper used by the class in one day. Each student will create a bar graph showing how much paper he or she used.

2. Bring a clear container to class, and fill it with candy, pencils, erasers, etc. Leave the container on display for the month. Students will estimate the number of objects inside. Count the contents of the container as a class. The person with the closest estimate wins what is in the container. Continue for several months, always using the same container. Students will create graphs to keep track of their estimates so they can see if their estimates improve over time.

Science

1. The volume of paper in landfills prevents it from ever having contact with soil. Soils hold the microorganisms necessary to help break paper down.
 - Students will conduct experiments to demonstrate this.
 - Divide students into groups, and provide each group with a one-gallon jar filled with shredded newspaper and another gallon jar with half soil and half newspaper.
 - Students will keep the contents of each jar moist for about a week.
 - Students will observe which jar of paper decomposes faster.

Extra Reading

Desonie, Dana, *Geosphere: The Land and Its Uses (Our Fragile Planet)*, Chelsea House, 2008.

Muldrow, Diane, and Bob Staake, *We Planted a Tree*, Golden, 2010.

Nivola, Claire A., *Planting the Trees of Kenya: The Story of Wangari Maathai*, Farrar, Straus and Giroux, 2008.

Vocabulary (cont.)

hemp—an annual herb which yields hashish, bird seed and hemp fiber, used in making rope

linen—a woven fabric made from the inner bark of the flax plant

loblolly—a mud hole

loblolly pine—a pine tree of the southeastern United States, having strong wood used as lumber and for paper pulp

microorganism—an animal or plant too small to be seen without a microscope

producer—someone who creates something by mental or physical effort

pulp—a product obtained from digesting wood in a slightly alkaline or neutral sodium sulfite cooking liquor

ream—a large roll of paper that has been pressed

renewable—capable of being replaced by natural ecological cycles or sound management procedures, e.g., water, wildlife, forests, and grasslands

resource—a usable stock or supply

trunk—the main wood axis of a tree

Name _____

Making Paper

The Pulp

1. Tear the used tissue or newsprint into pieces the size of the end of a crayon.
2. Measure 1/2 cup of the torn paper and two cups of hot water into a bowl or blender.
3. Beat the mixture with a blender or egg beater.
4. Mix in two teaspoons of instant starch to strengthen the paper. The pulp mixture should now be thick.

Optional: Decorate the pulp after it comes out of the blender by laying tiny leaves, flowers or other flat objects on the pulp.

The Process

1. Place the egg crate with the vinyl screen into the bottom of the 2-inch deep pan.
2. Add water to the 2-inch deep pan.
3. Pour the pulp mixture into the 2-inch deep flat pan and gently move it around until most of the pulp is floating evenly at the top.
4. Carefully lift the egg crate plastic with the screen. Try to hold the egg crate with the palm side of your hand. Finger marks will show. Hold it level, and let the excess water drain. Place pencils across the corners of the pan supporting the egg crate and screen.

5. Drop inclusions onto the damp weak pulp. Place name on pulp.

6. Count to 50, allowing the pulp to drain.

7. Move the crate, with screen, to the cookie sheet pan.

8. Place another screen on top of the fresh pulp.

9. Sponge off the sandwiched pulp. Top to bottom: screen, pulp, screen, egg crate, cookie sheet.

Materials Needed

- 2-inch deep pan
- vinyl screen (doesn't poke fingers)
- cut fluorescent light egg crate to fit pans (Use a band saw or hack saw.)
- large cookie sheet (Borrow one from the cafeteria)
- sponges
- 1 gallon can for each group
- 1 egg beater for each group
- 1 rolling pin
- dry iron
- newspaper
- 1 felt square for each group (Felt doesn't fade)
- used tissue or newsprint
- instant starch
- 1 inch by 1 inch pieces of paper for students to write their names with a pencil

Inclusions: fine threads from fabric, pansy petals, marigold seeds, tiny pieces of colored tissue

Water base markers can be used to add color.

10. Use a flat firm hand when sponging off the sandwiched pulp.
11. Slide the screen, pulp, screen to the newspaper.
12. Beginning at one corner, gently lift one corner of the screen. Thump the screen to release the sponged pulp. As the pulp releases pull the corner of the screen toward the opposite corner. You should be gently rolling one corner back toward the opposite corner.
13. You should have sponged off pulp, screen, and newspaper lying in a stack in front of you. Place the felt square on top of the pulp, screen, newspaper sandwich.
14. Turn this sandwich over so the newspaper is on top. Remove the newspaper. Remove the screen. You should be looking at the pulp. Place another piece of felt on top of the pulp.
15. Use the rolling pin to ROLL (Do not push the rolling pin.) across the sandwich of felt, pulp, felt. The rolling pin will remove more water, making the pulp stronger.
16. Carefully peel the felt back from the pulp.
17. Place a piece of smooth 12-inch by 12-inch fabric (old sheet) on top of pulp.
18. Gently turn the 12"x12" fabric, pulp, felt over so the felt is up. Peel the felt off as before.
19. Place the piece of wet paper in a quiet area to dry for 24 hours. (Leave the return air blowing overnight).
20. After drying, place the curled papers with names still imbedded in a stack.
21. Place a stack of six encyclopedias or heavy books on top of the dried paper.

